A DEVICE FOR RECORDING PRESSURE, PULSE VOLUME, AND MECHANOGRAM ON THE MPO-2 OSCILLOGRAPH

N. N. Vasilevskiy and O. Ye. Guzeyev

N65-35782

(ACCESSION NUMBER) 8 (PAGES) (NASA CR OR TMX OR AD NUMBER)

(THRU) 1 (CODE) 04 (CATEGORY)

FACILITY FORM 602

Translation of "Pristavka dlya zapisi davleniya, ob'yemnogo pul'sa i mekhanogramm na ostsillografe MPO-2".
Fiziologicheskiy Zhurnal SSSR, Vol. 49, No. 7, pp. 886-888, 1963.

GPO PRICE $ _____

CSFTI PRICE(S) $ _____

Hard copy (HC) 1.00

Microfiche (MF) .50

ff 653 July 65

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON D. C. SEPTEMBER 1965

A DEVICE FOR RECORDING PRESSURE, PULSE VOLUME, AND MECHANOGRAM ON THE MPO-2 OSCILLOGRAPH

N. N. Vasilevskiy and O. Ye. Guzeyev

(Central Scientific Research Laboratory I of the I. P. Pavlov Medical Institute, Leningrad)

ABSTRACT

35782

The authors describe the construction of a pneumovibrator to be used in recording pulse volume and blood pressure, in plethysmography, and in mechanograms. It is recommended for extensive use under experimental and clinical conditions. Author

The domestic MPO-2 oscillograph has found extensive application /886* in experimental and clinical medicine. It is possible to record different electric signals by means of this oscillograph. However, when recording such processes as, for example, blood pressure, pulse, respiration, etc., one must employ the appropriate converters (transducers) with special amplifying devices. It is necessary to employ them in many cases, but in the majority of cases simpler devices can be used. In 1954, D. N. Menitskiy used an optical manometer of the N. N. Savitskiy mechanocardiograph for these purposes.

We developed a simpler construction of the optical air manometer for

---

* Note: Numbers in the margin indicate pagination in the original foreign text.

the MPO-2 oscillograph (pneumovibrator). Experiments revealed great exploitation qualities: simpleness of construction, great reliability, sufficient linearity and stability of recordings, good sensitivity and relatively high eigen frequency of fluctuations.

Construction and Characteristics of the Pneumovibrator

The pneumovibrator is mounted within the body of a standard vibrator of the MPO-2 oscillograph. Its basic element is a hermetic capsule with a corrugated membrane made of polystyrene (Figure 1, 3).

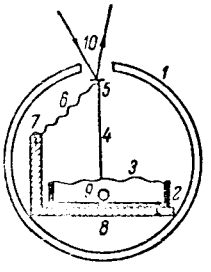

Figure 1

Diagram Showing Construction of Pneumovibrator

1 - Body of Standard Vibrator; 2 - Capsule Body; 3 - Corrugated Plastic Membrane; 4 - Metallic Band; 5 - Speculum; 6 - End of Metallic Band Attached to Support 7; 8 - Support; 9 - Aperture of Side Fitting for Attaching Connecting Air Tube; 10 - Opening in Vibrator Body.

The capsule is firmly attached to the supports 8. A resilient, fine, and narrow metallic band 4 is attached to the center of the membrane; the other end of this band 6 is rigidly attached to support 7. The speculum 5 from a standard vibrator is attached at the point where this band bends, which is located opposite the opening in the vibrator body 10.

The membrane is deflected in order to increase the pressure within the capsule. Its motion is transmitted to the speculum, which turns on its

axis and changes the direction of the reflected light ray.

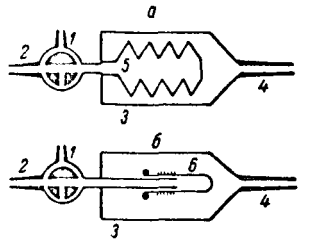

Figure 2

Schematic Representation of the Most Common Limiting Devices

а - With Corrugated Metallic Cylinder; b - With Rubber Cap.
1 - Three-way Cock; 2 - Cannula to Pressure Source; 3 - Body;
4 - Cannula to Air System of Pneumovibrator; 5 - Metallic Corrugated Cylinder; 6 - Rubber Cap.

The sensitivity of the vibrator depends on the membrane thickness. /887 The vibrator can be manufactured with a sensitivity ranging from several millimeters of an air column (with a membrane thickness of 15-20 microns) up to hundreds of millimeters of a mercury column (for a membrane thickness of more than 0.1 mm) throughout the entire width of the oscillograph film. In practical terms, it is advantageous to have vibrators with a high sensitivity, since it is possible to adapt them for measuring any pressure limit in the desired scale by using pressure limiting devices (transformers). In these cases, the pressure limiting devices supply only part of the pressure to the vibrator body, not deforming the form or amplitude of rapid fluctuations. The limiting devices shown in Figure 2 are the most advantageous ones.

The vibrator body is connected with the limiting device cavity or with the pressure source by means of a plastic tube having a diameter of 3-4 mm. The tube length must not exceed 1.5-2 meters for accurate measurements.

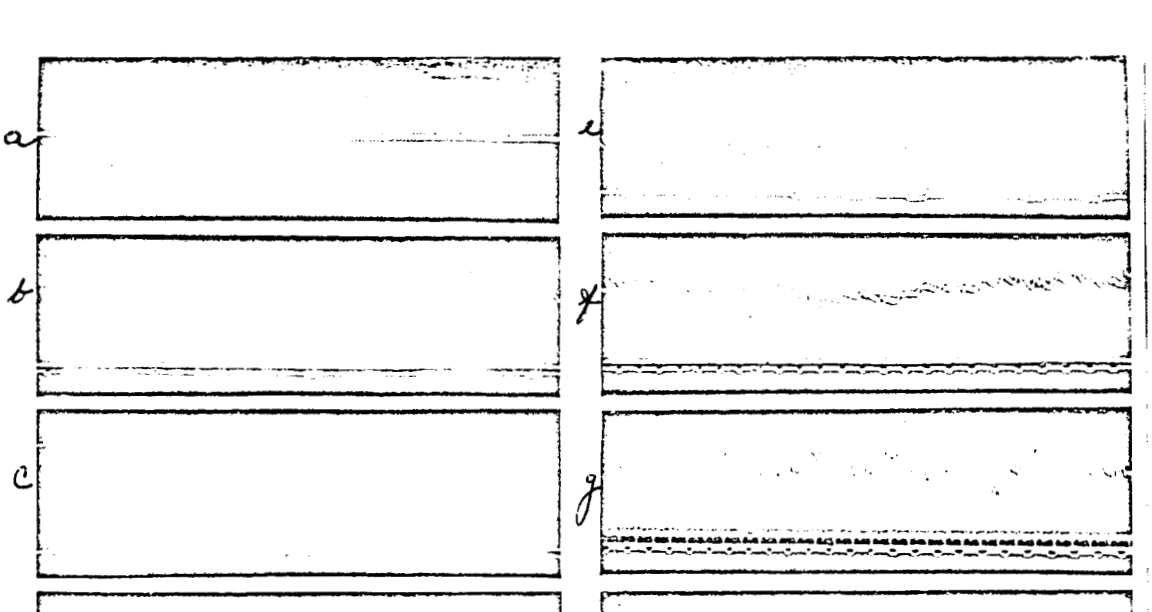

Figure 3

Samples of Oscillograms Obtained With a Pneumovibrator

Oscillograms: a - Eigen Frequency of Pneumovibrator (Recording Time 1/50 Seconds); b - Arterial Pressure in Carotid of Cat; c - Cerebrospinal Fluid Pressure in the Suboccipital Cisterna of a Cat; d - Pulse Volume of the Carotid in Man; f - Finger Plethysmogram when Cold Stimulus is Applied; g - Cardiac Impulse in Man; h - Movement of Mandibles During Mastication of Nut Kernel. On Oscillogram h: Upper Curve - Bioelectric Currents of Masticating Muscle; Middle Curve - Movement of Mandibles; Lower Curve - Time Marking (1 sec). In Remaining Oscillograms, a - g: Middle Curve - Zero Time Marking; Lower Curve - Time Marking (1 sec).

The pneumovibrator has a high eigen frequency, which is 400-500 /888 cycles, as a rule (Figure 3, a).

The vibrator readings are stable; their nonlinearity is not greater than 1-3%; the drift of the pneumovibrator is minimal and is observed

only in the first few minutes. The drift completely stops, since only a thermal equilibrium is established between the object, the air system of the pneumovibrator, and the surrounding medium. Therefore, several minutes after the pneumovibrator is connected, it must be verified that the ray is at the zero position. For this purpose, a three-way cock must be placed between the object and the limiting device or the air system of the pneumovibrator (Figure 2).

Application of the Pneumovibrator

Pulse Volume

The great sensitivity and the high eigen frequency of the pneumovibrator enable it to be used for recording the pulse wave and its propagation rate without any significant distortion of the form. The recording technique is simple. A Marey capsule is attached at the point where the arterial trunk is projected on the skin; this capsule has a fine rubber membrane and an element of porous rubber. The capsule cavity is directly connected (without a limiting device) by means of the three-way cock with the air system of the pneumovibrator. Figure 3, d, s show sample recordings of the pulse volume of the radial artery and the carotid in man.

Plethysmography

The pneumovibrator is particularly advantageous for recording the finger plethysmogram. Figure 3, f presents an example of a plethysmogram when a cold stimulus is applied to the antebrachium. The technique for recording the finger plethysmogram is also exceptionally simple. A cylinder, having the appropriate diameter, from a Luyer or "Rekord" syringe is slipped on to a finger which has been lightly lubricated

with vasoline. The syringe cannula is connected with the pneumovibrator by means of the three-way cock. The zero position of the ray is verified after several minutes.

A recording of the plethysmogram is possible from a Novitskiy-Mosso plethysmograph.

Pressure of Blood and Other Liquids

It is possible to record the absolute values of arterial, venous, cerebrospinal fluid, and intraocular pressure by means of the pneumovibrator. When the liquid pressure is measured, the air system of the pneumovibrator must be hermetically separated from the pressure source. This is most simply achieved by means of the limiting devices described above. In this case, the limiting device cavity is filled from one side with a physiological solution or with a citrate solution. The recording scale depends on the rigidity of the chosen limiting device.

The pneumovibrator is calibrated with a mercury or aqueous manometer. Figure 3, b, c presents sample recordings of the arterial and cerebrospinal fluid pressure in a cat.

Mechanograms

The pneumovibrator makes it possible to record on the oscillograph different mechanical processes - such as the motion of the thorax, the cardiac impulse, movement of the mandibles, limbs, contraction of individual muscles, etc. The technique for recording these processes does not differ from that described above. The sensors can be cuffs, rubber cylinders, or capsules which are connected with the air system of the pneumovibrator by means of the limiting devices having the chosen rigidity, or without them. Figure 3 presents sample recordings of the cardiac impulse in man (g) and

mechanograms during mastication of a nut kernel (h).

Thus, the described device is almost universal in its application for recording on a MPO-2 oscillograph different mechanical processes connected with a pressure change and processes which can change into pressure fluctuations in the recording system. The pneumovibrator can be recommended for extensive use under experimental and clinical conditions.

Its utilization in MPO-2 type oscillographs, with the recording on wide, self-winding paper, is particularly promising.

REFERENCES

1. Menitskiy, D. N. Fiziolog. Zhurn. SSSR, 40, No. 1, 94, 1954.

Received 7/9/1962.

Scientific Translation Service
4849 Tocaloma Lane
La Canada, California